

REMARKS/ARGUMENTS

Status

Claims 1 through 31 have been cancelled by the present amendment and claims 32 through 59 have been added. Independent claims 32, 48, 53, and 59 with claims 33-47, and 49-52 and 53-58 depending respectively therefrom will remain for further consideration.

More Clearly Defined

The claims in this application have been revised to voluntarily further clarify Applicant's unique invention. Applicant maintains that the claims as filed were patentable over the art of record. However, to expedite issuance of this application, reconsideration of the claims in light of the amendments and for the following reasons is respectfully requested.

Claim History

The Examiner rejected claims 1-11, 24-25 and 29-31 under 35 U.S.C. § 102 as being anticipated by Iwata. The Examiner rejected claims 12 and 26 under 35 U.S.C. § 103 over Iwata. The Examiner rejected claims 13 and 27 under 35 U.S.C. § 103 over Iwata in view of Gangadharan. The Examiner rejected claims 14 and 28 under 35 U.S.C. § 103 over Iwata in view of Linzy.

35 U.S.C. § 102

The Examiner rejected claims 1-11, 24-25 and 29-31 under 35 U.S.C. § 102 as being anticipated by Iwata. Claims 1-31 have been cancelled. This rejection will be discussed with respect to new claims 32-59.

The present invention is to a method and apparatus for link aggregation. By distributing information about local communication capabilities instead of making the information universally available, the distributed network is more readily scalable. A distant switch does not need to know which lines are available between two nodes to determine that information can be sent between the two nodes. A single collective indication that bandwidth capacity of a certain level is available on "a" line (as opposed to a specifically designated line) is sufficient to direct information to the proper link, as long as the local switch knows which line should carry the information once it gets to the switch.

The current invention teaches a method of further optimizing traffic by selecting the ideal local path from those available by selecting the lowest available capacity line sufficient to carry the traffic. Since the aggregated link reports the highest capacity of an individual physical line as indicative of the capacity of the aggregated link, by filling a lower capacity line with the requested traffic, the aggregated will continue to report a high capacity available. In other words, referring to Figures 6A and B of the present application, if a request for 3 time slots was received, by directing the traffic to link 140b, the maximum link capacity remains at 48. If instead, the request were directed to link 140c, the maximum capacity of a single line would drop to 45. Additionally, this optimizes the traffic on through the link by utilizing each link to its highest capacity and leaving other lines available for higher capacity traffic. Figures 7A and 7B show a second innovation of the present invention, namely, that the aggregated link between particular nodes can be divided into multiple links as needed to direct traffic of different classes of services or the

like. The virtual distribution of the physical lines can be distributed as needed to more easily and accurately show the available traffic across parallel links according to the service class and capacity, or by other similar requirements.

Turning to the claims, independent claims 32, 48, 52 and 59 remain for consideration. Claim 32 recites a method of aggregating physical links by determining line status, associating a plurality of links to create a first aggregated link and broadcasting the information about the aggregated link including the available bandwidth of the highest available capacity physical line of the aggregated link. The cited reference to lwata shows an ATM network having aggregated links. However, as best understood by the specification and drawings, lwata shows the available ("vacant") capacity of a link (i.e., the potential capacity, or "maximum transmission capacity" minus the current traffic), but the information on a particular link is not broadcast outside of the local database. Figures 5 and 6 of the lwata patent shows the "abstracted link management table" 65 which uses pointers to direct traffic to the desired channel, apparently based on internal calculations, and not necessarily distributed to other nodes. Information individual links is not shown, "only [the] abstracted link state information is notified by flooding to all of the switches." (Col. 4, lines 59-60) The aggregate capacity of the aggregated link is the only information transferred to other ports, not the maximum available capacity on an individual physical line, "A link abstracting portion aggregates physical link and the logical link connected to the common adjacent switch into one abstracted line, and notifies an abstracted link state information to a link state update protocol portion 68 described below." (Col. 5, lines 52-57) The present invention broadcasts the maximum capacity of an individual line in the aggregated link as recited in claim 32. This is nowhere found in the reference. For at least these reasons, claim 32 should be allowed.

Claim 33 further recites the use of a greedy algorithm to direct the traffic to the optimal lowest capacity channel having enough capacity to carry the traffic as discussed above and defined in the specification at paragraph 0054 et seq. This is nowhere shown in the Iwata reference. For at least this reason, claim 33 should be allowed over the art of record.

Claims 34 and 35 further recite that the aggregated link consists only of physical links between adjacent nodes. The Iwata reference aggregates physical lines and virtual lines, namely lines such as 40 in Figure 3 which are to indirect paths between two nodes through other nodes. This unnecessarily complicates the information contained and transferred between nodes, thus working against the purpose of the present application. Additionally, this results in paths of varying lengths or delays and the permutations of paths that must be updated from one node to another to determine whether indirect paths are currently operating works against the distribution of information on local direct paths. For at least these reasons, claims 34 and 35 should be allowed over the art of record.

Claim 36 further recites a second aggregate link. As described above and in the specification, parallel, physical links between two nodes may be divided into one or more aggregated links. Classes of service or other characteristics of one set of physical lines versus another set may make it more efficient to designate a group of the parallel lines as one aggregated link and another group as another aggregated link so that they may be shown graphically or more easily identified by information such as "available capacity by service class." This is nowhere shown in the Iwata reference, and for at least this reason should be allowable over the art of record.

Claim 37 further recites the method of claim 36 having only physical lines grouped into an aggregated link, and should be allowable for the reasons discussed above with reference to claims 34 and 35.

Claims 38 and 39 further recite aggregated links group by class of service, and should be allowable over the art or record for the reasons discussed above in reference to claim 36.

Claim 40 –47 further recite specific hardware provided in the operation of the method. These claims should be allowed for at least these reasons and those discussed above with regard to claim 32.

Independent claim 48 is to a method of directing information across a plurality of lines including grouping physical lines into a first aggregated link; storing status information about the aggregated link including the highest available capacity physical line within the link; and directing traffic across the link only if the capacity is sufficient to handle the traffic. As discussed above, Iwata does not store information about the capacity of the highest capacity line selected from the lines, but merely aggregates the capacity of all the lines and sends aggregate capacity to other nodes for comparison with the request bandwidth requirements. For at least these reasons, claim 48 should be allowed over the art of record.

Claim 49 further recites the selection of an optimal line to transfer requested information by selecting from those lines with adequate capacity, that line having the least capacity sufficient for the traffic. This is nowhere shown in Iwata and should be allowed for at least this reason.

Claims 50 and 51 further recites second aggregated link having a second class of service, and forwarding traffic across the aggregated link having the class of service in the received request. This is nowhere shown or taught by Iwata and these claims should be allowed for at least this reason.

Claim 52 depending from claim 51 further recites the selection of an optimal line to transfer requested information by selecting from those lines with adequate capacity, that line having the least capacity sufficient for the traffic. This is nowhere shown in Iwata and this claim should be allowed for at least this reason.

Independent claim 53 recites grouping physical lines into a first aggregated link, storing information about the aggregated link including available bandwidth, and storing information about the individual line capacities in the aggregate status information, and directing traffic across the link only if sufficient capacity existed. The Iwata device does not store information available to other nodes except as an abstracted aggregate of the bandwidth capacity of the link as a whole. For at least these reasons, claim 53 should be allowed over the art of record.

Claim 54 further recites the selection of an optimal line to transfer requested information by selecting from those lines with adequate capacity, that line having the least capacity sufficient for the traffic. This is nowhere shown in Iwata and this claim should be allowed for at least this reason.

Claims 55 and 56 further recites second aggregated link having a second class of service, and forwarding traffic across the aggregated link having the class of service in the received request. This is nowhere shown or taught by Iwata and these claims should be allowed for at least this reason.

Claim 57 and 58 further recite the method of claim 53 having only physical lines grouped into an aggregated link, and should be allowable for the reasons discussed above with reference to claims 34 and 35.

Independent claim 59 recites aggregating physical lines into an aggregated link, storing information about the aggregate link, and directing requested traffic across the link only if the link has the bandwidth capacity and the class of service requested, and selecting the optimal line as selecting from those lines with adequate capacity, the line having the least capacity sufficient for the traffic. For the reasons discussed above, this claim should be allowable over the art of record.

35 U.S.C. § 103

The Examiner rejected claims 12 and 26 under 35 U.S.C. § 103 over Iwata. The Examiner rejected claims 13 and 27 under 35 U.S.C. § 103 over Iwata in view of Gangadharan. The Examiner rejected claims 14 and 28 under 35 U.S.C. § 103 over Iwata in view of Linzy.

These claims have been cancelled by the present amendment. However, the references will be discussed with reference to the remaining claims 32-59.

Neither Gangadharan or Linzy shows the use of a greedy algorithm or the use of multiple classes of service or the use of multiple aggregated links or the broadcast of the individual line having the highest individual capacity. For these reasons, none of these references provides the deficiencies of the main reference, and thus the claims should be allowed over the art of record.

Summary

Applicants have made a diligent and bona fide effort to answer each and every ground for rejection or objection to the specification including the claims and to place the application in condition for final disposition. Reconsideration and further examination is respectfully requested, and for the foregoing reasons, Applicant respectfully submits that this application is in condition to be passed to issue and such action is earnestly solicited. However, should there remain unresolved issues that require adverse action, it is respectfully requested that the Examiner telephone Robert N. Blackmon, Applicants' Attorney at 703-684-5633 to satisfactorily conclude the prosecution of this application.

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Respectfully submitted,



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DRAWINGS

Formal Drawings

The indication by the Examiner in the recent Office Action that the formal drawings filed on February 1, 2002, were approved by the Draftsman is noted with appreciation.